forming a memory resistor bottom electrode;

forming a memory resistor material overlying the memory resistor bottom electrode;

forming a MSM metal bottom electrode overlying the memory resistor material, having a first work function;

forming a MSM semiconductor layer overlying the metal bottom electrode, having a second work function, less than the first work function; and,

forming a MSM metal top electrode overlying the semiconductor layer, having a third work function, greater than the second work function.

**10**. The method of claim 9 further comprising:

forming a memory resistor top electrode interposed between the memory resistor material and the MSM metal bottom electrode.

**11**. The method of claim 9 wherein forming the memory resistor material overlying the memory resistor bottom electrode includes forming the memory resistor from a material selected from the group comprising $Pr_{0.3}Ca_{0.7}MnO_3$ (PCMO), colossal magnetoresistive (CMR) film, transition metal oxides, Mott insulators, high-temperature super conductor (HTSC), and perovskite materials.

**12**. A metal/semiconductor/metal (MSM) back-to-back Schottky diode, the MSM diode comprising:

a substrate;

a metal bottom electrode overlying the substrate, having a first work function;

a semiconductor layer overlying the metal bottom electrode, having a second work function, less than the first work function; and,

a metal top electrode overlying the semiconductor layer, having a third work function, greater than the second work function.

**13**. The MSM diode of claim 12 wherein the metal top electrode and metal bottom electrode are the same material, having identical work functions.

**14**. The MSM diode of claim 12 wherein the metal top electrode and metal bottom electrode are materials selected from the group consisting of Pt, Au, Ag, TiN, Ta, Ru, and TaN.

**15**. The MSM diode of claim 12 wherein the semiconductor layer is a material selected from the group consisting of amorphous silicon (a:Si), polycrystalline Si, InOx, and ZnO.

**16**. The MSM diode of claim 12 wherein the semiconductor layer has a thickness in the range of about 10 nanometers (nm) to 100 nm.

**17**. The MSM diode of claim 12 wherein the metal top and bottom electrodes each have a thickness in the range of about 30 to 200 nm.

**18**. The MSM diode of claim 12 wherein the semiconductor layer includes a dopant selected from the group consisting of n-type and p-type dopants.

**19**. A resistance memory device with a metal/semiconductor/metal (MSM) back-to-back Schottky diode, the device comprising:

a memory resistor bottom electrode;

a memory resistor material overlying the memory resistor bottom electrode;

a MSM metal bottom electrode overlying the memory resistor material, having a first work function;

a MSM semiconductor layer overlying the metal bottom electrode, having a second work function, less than the first work function; and,

a MSM metal top electrode overlying the semiconductor layer, having a third work function, greater than the second work function.

**20**. The device of claim 19 further comprising:

a memory resistor top electrode interposed between the memory resistor material and the MSM metal bottom electrode.

**21**. The device of claim 19 wherein the memory resistor material overlying the memory resistor bottom electrode is a material selected from the group comprising $Pr_{0.3}Ca_{0.7}MnO_3$ (PCMO), colossal magnetoresistive (CMR) film, transition metal oxides, Mott insulators, high-temperature super conductor (HTSC), and perovskite materials.

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